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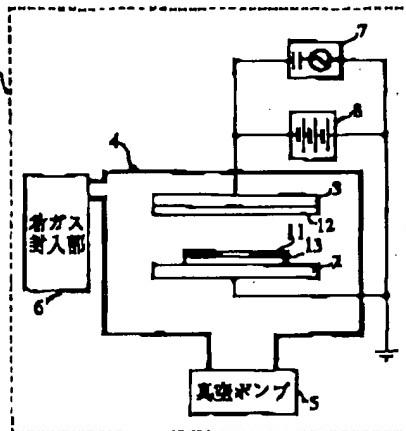
(54) PRODUCTION OF PLASTIC SUBSTRATE HAVING CONDUCTIVE LAYER

(57) Abstract:

PURPOSE: To provide a process for producing a plastic substrate having a conductive layer contributing to a decrease in curling which arises at the plastic substrate while assuring electrical conductivity and moistureproof performance.

CONSTITUTION: A base body 11 consisting of a PPS film is set on a base body holder 2 and a target object 12 consisting of a chromium plate is set on a target electrode 3. While a sputtering chamber 4 is evacuated by operating a vacuum pump 5, argon is sealed from a rare gas sealing section 6 into this chamber. Sputtering by a high-frequency glow discharge system is first executed by operating a high-frequency glow discharge device 7 while the internal pressure of the sputtering chamber 4 is regulated to 2×10^{-3} Torr. In succession, sputtering by a direct glow discharge system is executed by operating a direct glow discharge device 8.

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CLAIMS

[Claim(s)]

[Claim 1] It is the manufacture approach of the plastic plate which carries out sputtering of the metal by discharge in rare gas, and forms a conductive layer on a non-conductive plastic film. The 1st sputtering step which performs sputtering under the conditions which form a conductive layer which makes said plastic film curl to the sense which a conductive layer side consists of outside. The manufacture approach of a plastic plate with the conductive layer characterized by equipping the sense which a conductive layer side consists of inside with the 2nd sputtering step which performs sputtering under the conditions which form a conductive layer which makes said plastic film curl.

[Claim 2] The manufacture approach of a plastic plate with the conductive layer according to claim 1 characterized by for RF glow discharge performing sputtering and performing sputtering by direct-current glow discharge at said 2nd sputtering step at said 1st sputtering step.

[Claim 3] In the manufacture approach of an electroconductive-plastics substrate according to claim 1 said metal They are nickel or a tantalum. At the 1st sputtering step Sputtering is performed in the rare gas adjusted to low operating pressure lower than a predetermined pressure. At the 2nd sputtering step The manufacture approach of a plastic plate with the conductive layer according to claim 1 characterized by performing sputtering in the rare gas adjusted to high operating pressure higher than said predetermined pressure.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]**[0001]**

[Industrial Application] This invention relates to the approach of manufacturing a plastic plate with a conductive layer, by carrying out sputtering of the metal to a non-conductive plastic film.

[0002]

[Description of the Prior Art] The technique which forms the film of conductive metal metallurgy group oxide on a non-conductive plastic film is known, and the plastic plate manufactured by doing in this way is used as an ingredient of various electronic parts at first in the touch panel. As an approach of forming this conductive layer, sputtering and the technique to vapor-deposit are used in a metal (metallic oxide).

[0003] Sputtering strikes target bodies, such as a metal metallurgy group oxide, with the ion accelerated by discharge in rare gas, and sends the particle of a target body flying. Although this is made to adhere on a base (plastic film), and the adhesion of the film of a target body and base which were formed is good and is used comparatively well compared with vacuum deposition etc. from the ability of the metal metallurgy group oxide of the broad range etc. to be used as a target body. The utilization frequency is also increasing further with buildup of the need of the latest liquid crystal panel or a touch panel.

[0004] Although there are a direct-current glow discharge method and a RF glow discharge method in discharge at the time of sputtering and it is properly used according to the description which each has, in manufacture of an electroconductive-plastics substrate, a facility is comparatively cheap to it and many quick direct-current glow discharge methods of a sputtering rate are used for it.

[0005]

[Problem(s) to be Solved by the Invention] However, in the site which carries out sputtering of the metal to a plastic film in this way, and manufactures a plastic plate with a conductive layer, the problem that curl occurs has arisen in the manufactured plastic plate, and although the next activity is done using the plastic plate concerned, inconvenience has arisen. For example, in case a plastic plate is turned off in a predetermined dimension or is stuck, the workability will get very bad if the film has curled. When carrying out sputtering of the metal to a thin plastic film especially, the curl produced on a film is large and a problem is remarkable.

[0006] In order to reduce such curl, taking means to make thin thickness of the conductive layer formed in a plastic film is also considered. However, if a conductive layer is formed thinly, since the new problem that conductivity is spoiled, a pinhole occurs in a conductive layer with dust etc., or the moisture-proof engine performance of a conductive layer falls will arise, it cannot be called the outstanding solution means.

[0007] This invention aims at offering the manufacture approach of a plastic plate with the conductive layer which can reduce the curl produced in a plastic plate, securing conductivity and the moisture-proof engine performance in view of such a technical problem.

[0008]

[Means for Solving the Problem] In order to attain the above-mentioned object, invention according to claim 1 It is the manufacture approach of the plastic plate which carries out sputtering of the metal by discharge in rare gas, and forms a conductive layer on a non-conductive plastic film. The 1st sputtering step which performs sputtering under the conditions which form a conductive layer which

makes a plastic film curl to the sense which a conductive layer side consists of outside. The conductive layer side is characterized by equipping the sense which becomes inside with the 2nd sputtering step which performs sputtering under the conditions which form a conductive layer which makes a plastic film curl.

[0009] Moreover, invention according to claim 2 is characterized by for RF glow discharge performing sputtering and performing sputtering by direct-current glow discharge at the 2nd sputtering step at the 1st sputtering step to invention according to claim 1. Moreover, invention according to claim 3 is characterized by for a metal being nickel or a tantalum to invention according to claim 1, and performing sputtering in the rare gas which performed sputtering in the rare gas adjusted to low operating pressure lower than a predetermined pressure at the 1st sputtering step, and was adjusted to high operating pressure higher than a predetermined pressure at the 2nd sputtering step.

[0010]

[Function] Although curl tended to produce this invention person etc. in the plastic plate which carried out sputtering of the metal and manufactured it by sputtering to the inside which inquires about the approach of manufacturing a plastic plate with a conductive layer, to the plastic plate which carried out sputtering of the metallic oxide and manufactured it, the sense and extent of the data that curl seldom arises, and the curl of a plastic plate which carried out sputtering of the metal and manufactured it discovered the data are influenced by the conditions at the time of sputtering.

[0011] That is, about the metal of many including chromium or titanium, it turned out that a conductive layer side will be carried out outside and it will curl if a direct-current glow discharge method performs sputtering (it is hereafter indicated as out curl), and the inclination (it is hereafter indicated as Inn Carl) which will carry out a conductive layer side inside and will curl if a RF glow discharge method performs sputtering is shown.

[0012] About nickel or a tantalum, furthermore, irrespective of the method of glow discharge The sense which curls by whether it is higher than the predetermined pressure whose operating pressure at the time of sputtering is $4 - 5 \times 10^{-3}$ Torr extent, or low changes. It turned out that it will become out curl if sputtering is performed in the rare gas adjusted to low operating pressure lower than this predetermined pressure, and the inclination which will act as Inn Carl if sputtering is performed in the rare gas adjusted to high operating pressure higher than this predetermined pressure is shown.

[0013] Although the detailed place is not known yet about the reason the sense and extent of curl are influenced by the conditions at the time of sputtering, thus, according to the conditions at the time of sputtering That a difference arises in the crystal structure of the metal formed on a plastic film, or when a difference arises at spacing of the particles of a metallic crystal formed The case where a conductive layer expands a plastic film and produces out curl, and the thing which a conductive layer makes contract a plastic film and may make produce Inn Carl are conjectured.

[0014] By combining sputtering under conditions which are made to curl to the sense with which the conductive layer formed at the time of sputtering disagrees mutually paying attention to such a phenomenon, this invention person etc. found out that the curl produced in a plastic plate could be reduced, and resulted in this invention. According to invention according to claim 1, the conductive layer formed of the 1st sputtering step tends to carry out the out curl of the plastic film, and the conductive layer formed of the 2nd sputtering step tends to act as Inn Carl of the plastic film.

[0015] And curl of a plastic plate is reduced by offsetting an operation of the conductive layer which it is going to make curl to this opposite sense. Moreover, the laminating of each conductive layer formed at the 1st sputtering step and the 2nd sputtering step is carried out, and the thickness of the whole conductive layer becomes what doubled the thickness of each conductive layer.

[0016] Therefore, curl can be reduced while being able to adjust the thickness of a conductive layer freely by combining suitably the count which performs the 1st sputtering step, and the count which performs the 2nd sputtering step. Moreover, according to invention according to claim 2, the conductive layer formed by performing sputtering by RF glow discharge at the 1st sputtering step tends to carry out the out curl of the plastic film.

[0017] The conductive layer formed by performing sputtering by direct-current glow discharge at the 2nd sputtering step on the other hand tends to act as Inn Carl of the plastic film. Moreover, according to invention according to claim 3, the conductive layer of the nickel formed by performing sputtering

in the rare gas adjusted to low operating pressure lower than a predetermined pressure at the 1st sputtering step or a tantalum tends to carry out the out curl of the plastic film.

[0018] The conductive layer of the nickel formed by performing sputtering in the rare gas adjusted to high operating pressure higher than a predetermined pressure at the 2nd sputtering step on the other hand or a tantalum tends to act as Inn Carl of the plastic film.

[0019]

[Example] Hereafter, the example of the manufacture approach of a plastic plate with the conductive layer of this invention is explained concretely.

(Example 1) Drawing 1 is the outline block diagram of the sputtering system used by this example. The sputtering tub 4 which the sputtering system 1 equipped with the target electrode 3 equipped with the base holder 2 and the target body 12 equipped with a base 11 as shown in drawing, The vacuum pump 5 which can exhaust the sputtering tub 4 to a high vacuum, The rare-gas enclosure section 6 which can enclose rare gas with the sputtering tub 4 by the desired pressure, It consists of direct-current glow discharge device 8 grades which impress direct current voltage between the high frequency glow discharge device 7 which impresses high-frequency voltage between a base 11 and the target body 12, and performs high frequency glow discharge, and a base 11 and the target body 12, and perform direct-current glow discharge.

[0020] As a base 11, what carried out surface treatment (a solvent etc. washes) of 3.5 micrometers in thickness and the magnitude 10mmx100mm transparence polyphenyl ape fift (PPS) film was used. It set to the base holder 2, after sticking so that exfoliation can do first the support film 13 which supports this easily since handling was difficult for it if thickness remained as it was very thinly as for the base 11 of this film. As a support film 13, the polyethylene terephthalate (PET) film with a thickness of 50 micrometers was used. Moreover, this was set on the target electrode 3, using a chromium (Cr) plate as a target body 12.

[0021] And having enclosed the argon from the rare-gas enclosure section 6, and adjusting the internal pressure in the sputtering tub 4 to 2×10^{-3} Torr having operated the vacuum pump 5 and exhausting from the sputtering tub 4, the high frequency glow discharge device 7 was operated first, sputtering by the high frequency glow discharge method was performed, the direct-current glow discharge device 8 was operated succeedingly, and sputtering by the direct-current glow discharge method was performed.

[0022] RF glow discharge discharged for 162 seconds with the impression power of 2kw, and direct-current glow discharge discharged for 162 seconds with the impression power of 1kw. And after sputtering termination, ejection and the support film 13 were exfoliated from the sputtering tub 4 in the base 11, and the plastic plate with a conductive layer was manufactured. And about the manufactured plastic plate with a conductive layer, the thickness of the metal membrane used as a conductive layer was measured, and the condition of a metal membrane was also investigated. Moreover, curl length was measured using the curl length measuring instrument 20 shown in drawing 2.

[0023] The curl length measuring instrument 20 consists of standing ways 22 which support the soffit of the stainless plate 21 with a height of 130mm stood vertically and this stainless plate 21. The measuring method of curl length sticks the end of a plastic plate with a conductive layer on the upper bed of the stainless plate 21 of the curl length measuring instrument 20 with a double-sided tape, and hangs this. At this time, the field of the outside of curl of a plastic plate with a conductive layer is turned to a stainless plate 21, and is stuck. In this condition, the distance of the soffit of this plastic plate and a stainless plate 21 is measured, and let this be curl length. These measurement results are as being shown in the following table 1.

[0024]

[A table 1]

	塑性材質 厚(μm)	金属	放電 方式	カール の向き	カール長 (mm)	金属膜厚 (μm)
実験例 1	PPS 3.5	Cr	①高周波 ②放電	アロト	10	0.2
実験例 2	ポリイミド 12.5	Cr	①放電 ②高周波	アロト	6.5	0.2
実験例 3	PPS 3.5	Ti	①放電 ②高周波	(イン) イン	(27) 9	0.2
比較例 1	PPS 3.5	Cr	高周波 放電	アウト イン	43 41	0.1
比較例 2	ポリイミド 12.5	Ti	放電 高周波	イン アロト	33 53	0.1

The condition of a metal membrane was very smooth and the pinhole by dust etc. was not observed at all, either. Moreover, although some curl was produced in the plastic plate with a conductive layer, curl of this level checked that it was completely convenient practically, when using as an electrical circuit member of the head of an ink jet printer.

[0025] (Example 2) Although the manufacture approach of the plastic plate with a conductive layer of this example is the same as that of an example 1 The point of having used the polyimide film (the Du Pont-Toray make, trade name:Kapton 50H) with a thickness of 12.5 micrometers instead of the PPS film as a base 11, The point of having replaced the sequence of the RF glow discharge at the time of sputtering, and direct-current glow discharge, Namely, after operating the direct-current glow discharge device 8 first and performing direct-current glow discharge at the time of sputtering, it differs in that operated the high frequency glow discharge device 7, and high frequency glow discharge was performed.

[0026] And the thickness of a metal membrane, the condition of a metal membrane, curl length, etc. were checked like the example 1 about the manufactured plastic plate with a conductive layer. The measurement result was as being shown in a table 1, the condition of a metal membrane is very smooth and the pinhole by dust etc. was not observed at all, either.

(Example 3) Although the manufacture approach of the plastic plate with a conductive layer of this example is the same as that of an example 1, the sequence of the high frequency glow discharge at the time of the point of having used the titanium (Ti) plate instead of and sputtering, and direct-current glow discharge is replaced as a target body 12, and after operating the direct-current glow discharge device 8 first and performing direct-current glow discharge, it differs in that operated the high frequency glow discharge device 7, and high frequency glow discharge was performed. [a chromium plate]

[0027] And the thickness of a metal membrane, the condition of a metal membrane, curl length, etc. were checked like the example 1 about the manufactured plastic plate with a conductive layer. The measurement result was as being shown in a table 1, the condition of a metal membrane is very smooth and the pinhole by dust etc. was not observed at all, either. In addition, in this example, after the sputtering completion by direct-current glow discharge, the base 11 was taken out and the condition of curl was once checked. Inn Carl of 27mm of curl length was seen by the result as with the parenthesis showed with a table 1.

[0028] (Example 1 of a comparison) Although the plastic plate with a conductive layer was manufactured like the example 1, only sputtering by the direct-current glow discharge method was manufactured by performing only sputtering of a RF glow discharge method here. And the thickness of a metal membrane, the condition of a metal membrane, curl length, etc. were checked like the example 1 about the manufactured plastic plate with a conductive layer. The measurement result is shown in a table 1. Moreover, the pinhole considered to be based on dust was observed by the metal membrane.

[0029] (Example 2 of a comparison) Although the plastic plate with a conductive layer was manufactured like the example 2, only sputtering by the direct-current glow discharge method was manufactured by performing only sputtering of a RF glow discharge method here. And the thickness of a metal membrane, the condition of a metal membrane, curl length, etc. were checked like the

example 1 about the manufactured plastic plate with a conductive layer. The measurement result is shown in a table 1. Moreover, the pinhole considered to be based on dust was observed by the metal membrane.

[0030] (Example 4) The manufacture approach of the plastic plate with a conductive layer of this example Although the point of performing sputtering by performing glow discharge is the same as an example 1, enclosing an argon under reduced pressure using a sputtering system 1 using 3.5 micrometers in thickness, and a magnitude 10mmx100mm transparence PPS film as a base 11 It differs in that only a RF glow discharge method performs and sputtering is performed combining two operating pressure, low operating pressure and high operating pressure, using a nickel (nickel) plate as a target body 12.

[0031] Namely, in this example, at the time of sputtering, the internal pressure of the sputtering tub 4 was first adjusted to 2×10^{-3} Torr, the high frequency glow discharge device 7 was operated, the internal pressure of the sputtering tub 4 was successively adjusted to 6×10^{-3} Torr, and the high frequency glow discharge device 7 was operated (impression power is 2kw(s) and glow discharge time amount is 162 seconds respectively). And the thickness of a metal membrane, the condition of a metal membrane, curl length, etc. were checked like the example 1 about the manufactured plastic plate with a conductive layer. A measurement result is shown in the following table 2.

[0032]

[A table 2]

	被膜材質 厚(μm)	金属 基板	放電 方式	動作圧 (Torr)	カール の向き	カール 長(mm)	金属膜厚 (μm)
実験 例4	PPS 3.5	Ni	高周 波	① 2×10^{-3} ② 6×10^{-3}	アウト	4	0.2
実験 例5	ポリイミド 12.5	Ta	直流	① 6×10^{-3} ② 2×10^{-3}	アウト	7	0.2
比較 例3	PPS 3.5	Ni	高周 波	2×10^{-3}	アウト	11	0.1
				6×10^{-3}	イン	28	0.1
比較 例4	PPS 3.5	Ni	高周 波	① 0.7×10^{-3} ② 6×10^{-3}	イン	14	0.2
				① 2×10^{-3} ② 0.5×10^{-3}	アウト	29	0.2

The condition of a metal membrane was very smooth and the pinhole by dust etc. was not observed at all, either. Moreover, curl of a plastic plate with a conductive layer was extent which is convenient small practically.

(Example 5) Although the manufacture approach of the plastic plate with a conductive layer of this example is the same as that of an example 4 The point of having used the polyimide film (the Du Pont-Toray make, trade name:Kapton 50H) with a thickness of 12.5 micrometers instead of the PPS film as a base 11, The point of having used the tantalum (Ta) plate instead of the nickel plate as a target body 12, A direct-current glow discharge method is used instead of a RF glow discharge method at the time of sputtering. At the time of the point, i.e., sputtering, of having replaced the sequence of low operating pressure and high operating pressure After adjusting the internal pressure of the sputtering tub 4 to high operating pressure (6×10^{-3} Torr) first and operating the direct-current glow discharge device 8, it differs in that adjusted the internal pressure of the sputtering tub 4 to low operating pressure (2×10^{-3} Torr), and the direct-current glow discharge device 8 was operated.

[0033] And the thickness of a metal membrane, the condition of a metal membrane, curl length, etc. were checked like the example 4 about the manufactured plastic plate with a conductive layer. A measurement result is shown in a table 2. The condition of a metal membrane is very smooth and the pinhole by dust etc. was not observed at all, either.

(Example 3 of a comparison) Although the plastic plate with a conductive layer was manufactured like the example 4, only sputtering of the RF glow discharge method in low operating pressure (2×10^{-3} Torr) performed only sputtering of the RF glow discharge method in high operating pressure (6×10^{-3} Torr) here.

[0034] And the thickness of a metal membrane, the condition of a metal membrane, curl length, etc. were checked like the example 4 about the manufactured plastic plate with a conductive layer. The measurement result is shown in a table 2.

(Example 4 of a comparison) although the plastic plate with a conductive layer was manufactured like the example 4 -- here -- as the value of low operating pressure -- instead of [of 2×10^{-3} Torr] -- 0.7×10^{-3} Torr -- or 9.5×10^{-3} Torr was used instead of 6×10^{-3} Torr as a value of high operating pressure.

[0035] And the thickness of a metal membrane, the condition of a metal membrane, curl length, etc. were checked like the example 4 about the manufactured plastic plate with a conductive layer. The measurement result is shown in a table 4.

[Consideration] It can consider as follows from the above measurement results of an example and the example of a comparison etc.

[0036] In the case of direct-current glow discharge, the example 1 of a comparison in a table 1 and the sense of curl of two show that the inclination which produces out curl is shown in the case of Inn Carl and RF glow discharge in chromium or titanium. Moreover, the sense of curl of the example 3 of a comparison in a table 2 shows that the inclination which produces Inn Carl is shown in nickel at the low operating pressure of 2×10^{-3} by out curl and the high operating pressure of 6×10^{-3} .

[0037] Moreover, in a table 1, the curl length of examples 1-3 is reducing each greatly compared with the curl length of the examples 1 and 2 of a comparison. As for the sequence of that curl length can be reduced, and direct-current glow discharge and RF glow discharge, by combining direct-current glow discharge and RF glow discharge from this in the case of which [of chromium and titanium] shows that the point is sufficient as whichever.

[0038] Moreover, in a table 2, the curl length of an example 4 is decreasing greatly compared with the curl length of the example 3 of a comparison. Moreover, also in an example 5, since small curl length has been obtained, in nickel and a tantalum, by combining sputtering of low operating pressure and high operating pressure shows that curl length can be reduced. Here, as for the sequence of that there is effectiveness in the case of which [of direct-current glow discharge and RF glow discharge], and low operating pressure and high operating pressure, it turns out that the point is sufficient as whichever. However, if it sees from actuation, it will think that it is [operability] better to perform low operating pressure previously.

[0039] Moreover, in a table 2, although curl length is large in the example 4 of a comparison compared with the example 4 When this performs sputtering combining low operating pressure and high operating pressure like an example 4, perform the range of operating pressure in the range of 1 - 9×10^{-3} Torr. That is, it has suggested that the range of 1 - 4×10^{-3} Torr is suitable as a value of low operating pressure, and the range of 5 - 9×10^{-3} Torr is suitable as a value of high operating pressure.

[0040] Moreover, in a table 1 and a table 2, in 1-time discharge, all, in 0.1 micrometers and 2 times discharge, the thickness of a metal membrane is all 0.2 micrometers, and is proportional to the count of discharge. As mentioned above, although the example of this invention was explained, this invention is not a limiting-to content indicated by above-mentioned example thing.

[0041] For example, in the case of Inn Carl and RF glow discharge, also in metals, such as aluminum, palladium, gold, silver, copper, and platinum, in the case of direct-current glow discharge as well as the examples 1 and 2 of a comparison, since the inclination of out curl is shown, it can carry out like [metals / these] examples 1-3. However, although the curl reduction effectiveness by this invention also appears notably since curl tends to occur especially in the case of chromium or titanium, it is thought that effectiveness is not so remarkable as chromium or titanium in the case of other metals.

[0042] Moreover, in the above-mentioned examples 1-3, although the internal pressure in the sputtering tub 4 was adjusted to 2×10^{-3} Torr and was performed, in the general operating pressure 10.2 - 10.4Torr, it can carry out similarly. Moreover, in the above-mentioned examples 1-3, in the example and examples 2-5 which perform RF glow discharge and direct-current glow discharge once [every] each, although the example which discharges once [every] each by low operating pressure and high operating pressure was shown, when forming a metal membrane still more thickly, the metal membrane to the thickness of about 0.5 micrometers can form the count of discharge easily an increase and by carrying out and carrying out repeatedly.

[0043] Moreover, the thickness of the plastic film which can generally be used as a base 11 of the above-mentioned examples 1-5 is about 250 micrometers or less, and thickness is considered that the curl reduction effectiveness is remarkable in the thin flexible plastic film which is 1-100-micrometer (especially 1.5-50 micrometers) extent. Moreover, as construction material of a plastic film, the thing excellent in thermal resistance or dimensional stability is desirable. For example, polypropylene, polyethylene phthalate, a polyamide (aromatic series, aliphatic series), A polycarbonate, polyether sulphone, polyarylate, a polyether ketone, the poly PARAKI silylene, the poly FENREN sulfide, Pori parabanic acid, thermoplastic polyimide, thermosetting polyimide, and thermosetting polyamidoimide can be mentioned. It is desirable construction material at the point that polyethylene phthalate, polyether sulphone, a polyether ketone, polyarylate, and polyimide are excellent in thermal resistance and dimensional stability also in this, and a thin film can be obtained.

[0044] Although these plastic films may be used while it has been unsettled, it is desirable to carry out surface treatment and to use by the physical method (clearance of dust etc.), the physicochemical approach (washing by the solvent, water, etc., corona discharge), and the chemical approach (scaling, surface roughening by chemicals). Moreover, in the above-mentioned examples 1-5, although the example using an argon as rare gas was shown, in addition even if it uses a krypton, helium, etc., it can carry out similarly.

[0045] Moreover, in the above-mentioned examples 1-5, although 1 time of glow discharge time amount was made into 162 seconds, this glow discharge time amount is good to set to a suitable value in the range for about 1 - 3 minutes through an experiment according to the thickness of a required metal membrane, the magnitude of impression power, extent of curl, etc. Moreover, the charging time values of each time at the time of carrying out repeat glow discharge may differ mutually.

[0046] Moreover, in the above-mentioned examples 1-5, it is 0.2 which is the impression power of general RF glow discharge - 3kw extent (0.5-2kw is efficient), and 0.2 which is the impression power of general direct-current glow discharge - 10kw extent (0.5-5kw is efficient), and impression power of RF glow discharge can be similarly carried out, although impression power of 2kw(s) and direct-current glow discharge was set to 1kw.

[0047]

[Effect of the Invention] combining RF glow discharge and direct-current glow discharge at the time of sputtering according to the manufacture approach of a plastic plate with the conductive layer of this invention -- or curl of a plastic plate can be reduced, securing the engine performance (namely, conductivity and non-moisture permeability) of the conductive layer formed by combining low operating pressure and high operating pressure.

[0048] And the workability at the time of performing the following process using this improves by reducing curl of a plastic plate. Since the effectiveness of the curl reduction at the time of manufacturing a thin plastic plate especially is remarkable, the plastic plate used for the electrical circuit member of the head of an ink jet printer has the large practical effectiveness in the field future need is expected to be.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the outline block diagram of the sputtering system concerning the example of this invention.

[Drawing 2] It is the perspective view of the curl length measuring instrument concerning the example of this invention.

[Description of Notations]

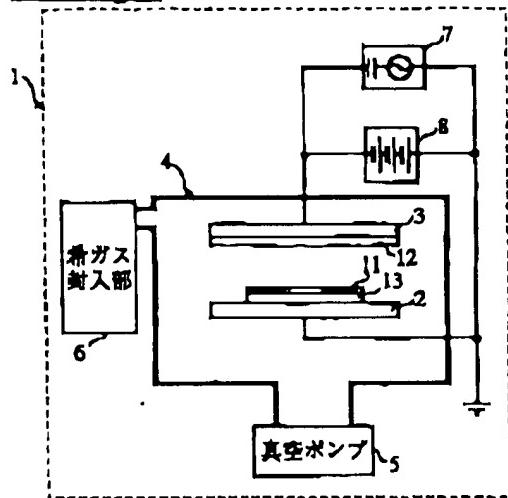
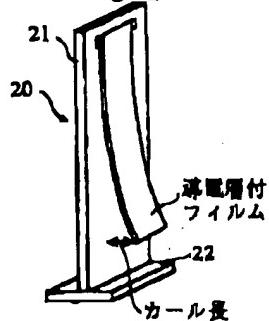
- 1 Sputtering System
- 4 Sputtering Tub
- 7 High Frequency Glow Discharge Device
- 8 Direct-Current Glow Discharge Device
- 11 Base
- 12 Target Body

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DRAWINGS**[Drawing 1]****[Drawing 2]**

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